answered by the fact that, according to Mr. Hill, the epochs of heaviest winter rain are approximately those of *highest* mean annual temperature. E. DOUGLAS ARCHIBALD

Distribution of the Black Rat

MR. MIDDLETON'S letter in NATURE, vol. xix. p. 460, induced me to inquire whether the black rat still occurs in Dresden, the museum under my care possessing several specimens, which were procured on the spot several years ago. The streets where this rat then occurred being known to me, viz., Meissener-strasse, Alaun-gasse, Königsbrücker-strasse, all on the right bank of the Elbe, in Dresden-Neustadt. I inquired in many houses, offering a relatively high reward for a specimen, but hitherto in vain. The museum possessing further a specimen from a place called the Schenkhübel, about an hour's walk from the town, in the direction of the last of the above-named streets, I had traps put there, but also in vain; only the brown rat, *Mus decumanus*, could be procured.

Every two years a general rat poisoning being ordered by the magistrate of the town, I shall wait till the next one (March, 1880), and then try to state whether *Mus rattus* still lives in Dresden, as it no doubt lived here several years ago.

The museum possesses besides specimens from Mühlhausen, in Thuringia, and a series from Saxe-Altenburg; in the latter country I do not know the exact locality, the man—a dealer—who sent them, being very mysterious on this point, but I have indubitable evidence that it still lives there, and even is not rare on some spots. Knowing that it occurred some time ago in the brewery of Blankenhain Castle, near Crimmitzschau, in Saxony, I inquired there, but got the answer that for two years it has been replaced by *M. decumanus*.

Therefore, I am not sure that *M. rattus* still lives in the kingdom of Saxony, but I *am* sure that it occurs in the Saxon Duchies. I shall publish the results of my further inquiries in case they are successful.

From the Malay Archipelago I brought *M. decumanus*, but not *M. rattus*. I got specimens from North and South Celebes, besides other localities, but as the *Mures* in my collections are not yet definitely determined, I cannot give more particulars now. A. B. MEYER

Royal Zoological Museum, Dresden, May 3

Mice and Beetles

PERMIT me to ask, through the medium of your columns, if it is known whether mice kill the common kitchen black-beetle. I have been unable to find anything bearing upon this subject, but having observed that there is an apparent reduction in the number of beetles, or at least no increase in number while the mice are permitted to live, and also that the mice do not touch any articles of food in the kitchen, where they are somewhat numerous, I have been led to think that they prey on the beetles in some way. W. WORBY BEAUMONT

The Cause of Thunder

I HAVE lately seen it stated in a text-book upon electricity and magnetism that the phenomenon of thunder is not fully accounted for by any theory as yet brought forward. Whether this be so or not I am not sufficiently acquainted with the subject to say. I believe the commonly accepted theory is that a vacuum is created in the path of the electric spark and that the subsequent in-rush of the air produces the detonation. If, however, it be allowed that the electric spark is not a material substance, but merely a natural force or mode of motion, the possibility of this theory is at once disposed of.

It is a well-known fact that the passage of electricity in a high state of tension, through a mixture of oxygen and hydrogen, not only causes an explosion, but also causes the formation of water, and it seems to me that, given the existence of free oxygen and hydrogen in the region of the electric disturbance, the phenomenon of thunder is sufficiently accounted for.

Whether the normal amount of hydrogen in the air is sufficient to cause the stupendous noise of thunder I am not competent to judge, but if not I would suggest that the presence of an abnormal amount might be accounted for by the process of the electrolysis, which would probably occur between the two poles of the thunder-cloud before the tension became so great as to cause a rupture of the circuit and consequent discharge of the electric spark. I would also draw your attention to the fact that every thunder-clap is immediately followed by an increase in the quantity of water deposited in the shape of rain. Does not this point to the formation of water by the explosion of the gases?

As I myself am unable both from want of means and time to investigate the matter, I should be glad to find that someone better qualified had taken the subject in hand. It is a frequent experiment of Dr. Tyndall's to show his audience real clouds; I feel convinced that by following this line of inquiry he could give us a real thunderstorm. S. A. R.

The April Meteors

ON the night of the 20th these meteors were watched for between 10h. 45m. and 11h. 30m., after which the stars were obscured by a dense fog. During the $\frac{3}{4}$h. of observation 15 shooting-stars were counted, of which 4 or 5 only belonged to the shower of *Lyrids*. These were faint and somewhat slow, with slight trains and short paths. The radiant point could not be exactly fixed. Of the other meteors three were brilliant (2 = 1st mag. and 1 = 2nd mag.), and moved with extreme swiftness from a radiant point at 286° + 23°. They left bright greenish streaks, and were readily distinguished from the *Lyrids*, though the radiants lie near together. This new shower near β Cygni (Albireo) appears to form an important display at this epoch. I saw several bright, rapid meteors from it on April 20–21 last year, and determined the position of its radiant point from a number of shooting-star paths given in Dr. Weiss's two volumes of Austrian observations at 288° + 22° (20 meteors) for the period April 19–23 (see *Monthly Notices* R.A.S., vol. xxxviii. p. 396). It is further confirmed by a stationary meteor recorded by Palisa at Troppau on April 19, 1870, at 289°·4 + 26°·4, and it will be advisable to look out specially for this prominent shower of swift, streak-leaving meteors during future returns of the *Lyrids*. The latter display has quite failed during the last few years. W. F. DENNING

Ashleydown, Bristol, April 22

Salmo salar and the Schoodic Salmon

UNDER date of March 13, in the course of remarks on a late report of the U.S. Commissioner of Fish and Fisheries, you express a wish for an explanation of the fact that a sea-going salmon (*Salmo salar*) was found among the Schoodic "land-locked" salmon. I take pleasure in supplying the explanation. The fish referred to were taken in Grand Lake Stream, which connects two of the Schoodic lakes, tributary to the St. Croix River, which discharges into an arm of the sea on the border between the United States and Canada. Before the obstruction of the St. Croix by mill-dams, there was nothing to prevent the ascent of the sea-going salmon to this stream, and it is among the traditions of the aborigines that they were formerly often taken here along with the small "land-locked" or fresh-water salmon. The sea-salmon they called Pl-láhm; the land-locked, Tag-e-wáh-nàhn; and though for many years the sea-salmon were almost wholly prevented from ascending the river by the mill-dams, they have not been entirely exterminated, and the upper waters have been rendered in a degree accessible to the remnant by means of fish-ways constructed within a few years.

The specimen taken was, at the close of the season, set free with the other captured fish, and doubtless returned to sea.

I will add that the latest studies of American ichthyologists on the subject have led to the conclusion that the Schoodic and other "land-locked" salmon are specifically identical with *Salmo salar* (*vide* Jordan, "Manual of the Vertebrates of the Northern United States," 1878, p. 357).

Grand Lake Stream, CHAS. G. ATKINS,
Maine, U.S.A., April 9 Asst. to the U.S. Commissioner,
Fish and Fisheries

Intellect in Brutes

A FEW months ago I made the acquaintance of a dog, which, I think, is worthy of a place among the dogs, and cats, and rats, and mules that are helping the pages of NATURE to determine the degree and kind of animal intelligence.

"Priest's" is a hotel on the way from the Calaveras Grove of Big-trees to the Yosemite. In former years, on the arrival of the stage, the landlady would send the dog to the poultry yard to catch chickens for the tourists' dinner. Now the dog "takes time by the forelock." The stage is due at six o'clock. About

© 1879 Nature Publishing Group

five o'clock the dog saunters leisurely down the road till he meets the stage, he then bounds back to the poultry-yard, catches chickens, bites their heads off, and takes them to the cook! The number of chickens he kills bears a relation to the number of passengers he saw in the stage.

A gentleman who was stopping at the hotel for a few days went into the woods one afternoon with a gun. When he returned the dog came to him in much excitement to see what game he had taken. Finding his hands and his bag empty the dog ran into the forest and returned in less than an hour with a bird, which he gave with an air of compassion to the unskilful hunter.

W. D. Gunning

Waltham, Mass., April 18

ON THE EVOLUTION OF THE VERTEBRATA[1]

SEVERAL theories of the vertebrate skeleton have been promulgated during the last century, some of which have since been abandoned, and others greatly modified. About a quarter of a century ago, three great stumbling blocks were removed from the study of animal forms, by the discovery that the cell-wall was not essential as inclosing sarcode, by the removal of the old conceptions about the origin of species, and by the rejection of the vertebrate theory of the skull in its older and grosser form. In the present course, the lecturer wishes to give both an analytic and synthetic account of the vertebrate skeleton, to see if a consistent history cannot be given of every cartilage, bone, and joint, in the higher types.

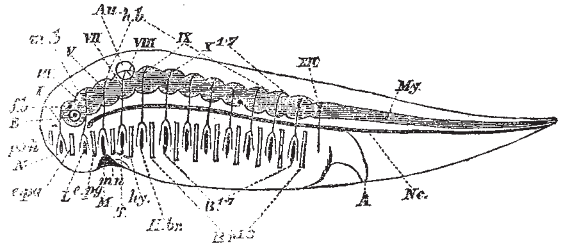
A vertebrated animal is constructed of a chain of segments similar to each other, which are obsolete in the head, and in each of which there is a smaller dorsal tube, through which the continuous neural axis runs, and a larger ventral tube, which contains the digestive organs, heart, and main blood vessels. The neural axis swells into three main vesicles in the head, giving rise to the fore, mid, and hind brain. The skeletal structures are formed on a single median axis, the notochord, which lies directly beneath the neural axis, and which is arrested in the head close behind the fore-brain. The barrier, however, which would stop the growth forwards of the notochord, is not developed when its apex shrinks. By the time the embryo is fairly formed, a fold of the palatal skin has given rise to a sac which opens into the lower and hinder part of the fore-brain. This sac is the pituitary body, the manner of the development of which has been clearly made out by Mr. Balfour, in the sharks and skates, and corroborated by the lecturer in the snake, lizard, and green turtle.

The mouth and posterior aperture do not exist at first, but are formed afterwards as involutions, which, in the latter case, at any rate, are not terminal, the alimentary tract extending behind the anus, and possibly in front of the mouth also in ancient forms. The visceral clefts appear as slits in the wall of the pharynx, and in the aquatic forms, give rise to the gills, while in the higher types (amniota), all of them close up but one, which remains as the tympano-eustachian cavity. The vertebræ alternate with the primary segmental masses. Each centrum, as it chondrifies, constricts the notochord, but there is usually some remnant of it to be seen in the adult in the invertebral spaces. The walls of the head are large and continuous, and its lower arches are generally small, clefts appearing between them. Both the arches and clefts become greatly modified in the adult, especially in the higher types. Thus the upper jaw is probably due to the modification and blending together of two or three pairs of arrested arches.

Besides the axial skeleton, a cartilaginous skeleton is developed immediately under the skin, and thus there is both a cartilaginous exo- and endoskeleton. The exoskeleton gives rise to the labial and extra-branchial cartilages, the limb arches and their limbs, and the intercalary cartilages of the median fins of fishes.

The bony parts of the skeleton are classified according to their relation to the axial or extra-axial cartilaginous skeletons. All bony scales, scutes, or sub-cutaneous bony plates, or tracts, are classified as exoskeletal; ossifications of the endoskeletal cartilage or its perichondrium are, of course, endoskeletal. Unfortunately for science, the extinct lower forms of the Vertebrata had their endoskeletons but slightly ossified, and thus only the outworks of their structure are left to us, as is the case with many of the Ganoids of the old red sandstone. The lowest of these, however, were half way up the vertebrate scale, if we compare them with the lancelet. Of existing brain-bearing fishes the lamprey and hag are the lowest, but man scarcely stands at a greater distance from them than they do from the lancelet, which, as far as we know at present, stands alone in creation.

Until we can connect the known Vertebrata, or at least their embryos, with the worm-like Invertebrata, the former will continue to be a very anomalous group. The difficulty is not with man; in him we have organ for organ and part for part, and he is better than a beast only by reason of something that cannot be demonstrated by the anatomist as such.



A, anus; *Au*, auditory capsule; B^{1-7}, branchial clefts; Br^{1-8}, branchial arches; *E*, eye; *e.pa*, ethmo-palatine; *e.pg*, epi-pterygoid; *f.b*, fore-brain; *h.b*, hind brain; *H.br*, hyo-branchial cleft; ***hy***, hyoid arch *L*, lacrymal cleft; *M*, mouth; *m.b*, mid-brain; ***mn***, mandible; *My*, myelon; *N*, nostril; *Nc*, notochord; *p.rh*, pro-rhinal; *T*, tympanic cleft. The Roman figures indicate the nerves.

The above diagram represents an ideal vertebrate, the oral, lacrymal, and nasal clefts being taken as homologous with the post-oral clefts. This theory seems probable both from the author's researches on the visceral arches and clefts, and those of Milnes Marshall on the nerves. The seven branches of the vagus (x^{1-7}) are here shown as separate nerves, and the hind brain as a series of enlargements.

As the relation of the endoskeleton to the exoskeleton does not usually seem to be properly understood, it may be as well to say a few more words about it. On the whole the foundations of the internal skeleton are laid in cartilage, and of the external in bone, which is formed by the ossification of fibrous tracts. The cartilage as a rule also ossifies, and this inner or *cartilage* bone has, so to speak, an organic affinity for the outer or *membrane* bone. But there are several things in the vertebrate exoskeleton that are formed of cartilage, as already mentioned; and in the endoskeleton the cartilage is often suppressed in certain parts, bony substance, formed in fibrous tissue, replacing it. Indeed, unossified fibrous tracts often take the place of cartilage. The welding together of parts originally distinct makes the matter much more complicated. No inherited elements are rejected by the morphological force; they are only kept from growing into special tissues until needed. Thus the rich growth of the human brain is covered in with a stout masonry that is merely made up of the inner layer of old ganoid plates, and the cartilages of the human nostril are inheritated from some ancient sucking fish, while the outer ear once figured, speaking morphologically, as the blow-hole of some Silurian shark.

A word or two must now be said about the different kinds of ossification. When the perichondrium, or clothing

---

[1] Abstract of Prof. Parker's Hunterian Lectures, delivered at the College of Surgeons, commencing on February 10.

© 1879 Nature Publishing Group